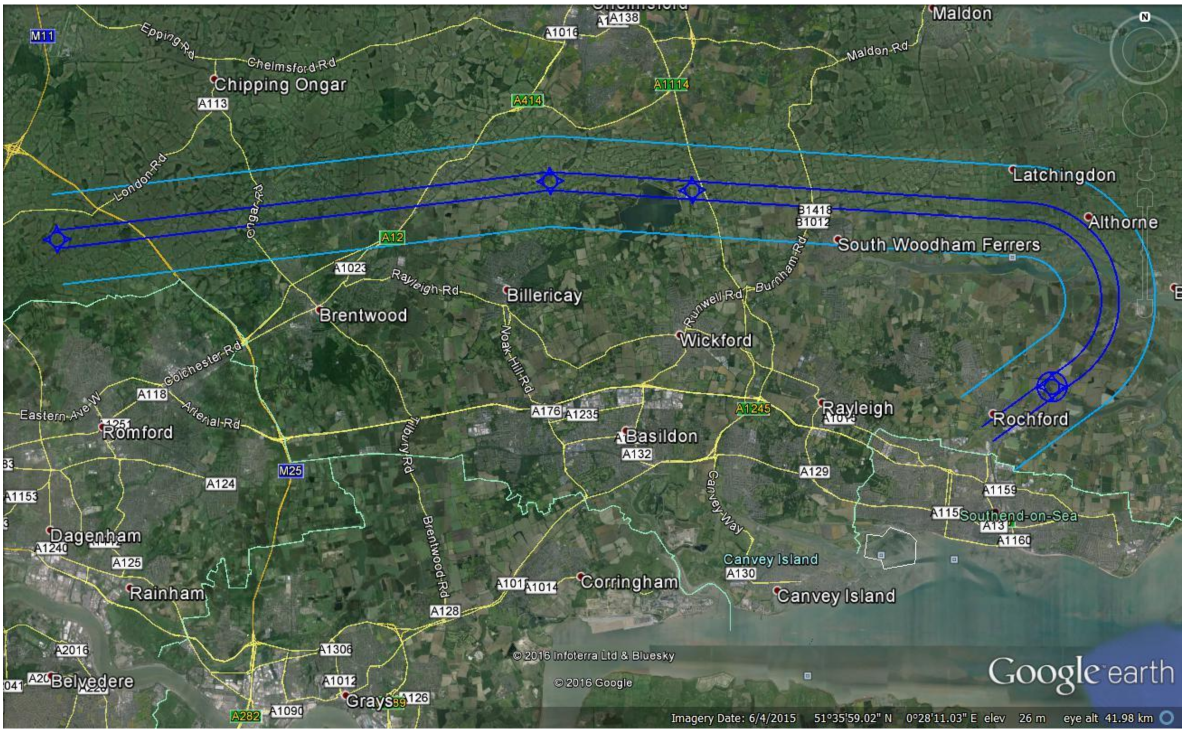
London Southend Airport
Airspace Change Proposal

Introduction of Standard Instrument Departure Procedures to Routes in the London Terminal Control Area

Sponsor Consultation - 2016

Annex D to Part B
of the Consultation Document
Runway 05 Departures via EVNAS – LAM



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1. Runway 05: Departures to the west (EVNAS – LAM).

1.1. The procedure is known as the **LAM 1G** SID and reflects, as closely as practicable within the procedure design criteria, the PDR from runway 05[1].

1.2. EVNAS is a position within the LTMA approximately 2NM west of Hanningfield Reservoir and has previously been used to define the historic PDRs from LSA. LAM is the site (near to Stapleford Aerodrome) of a ground-based navigational facility (Lambourne VOR/DME) which defines a number of Airway alignments and traffic flows which are essential to the operation of the LTMA, in particular the traffic flow inbound to Heathrow from the east[2].

1.3. It is emphasised at the outset that the portion of the SID from EVNAS to LAM is essentially for flight planning purposes only, in order to provide procedure design linkage to the LTMA route network. Aircraft will seldom actually follow this portion of the SID as they will, normally prior to EVNAS, have been given further climb clearance and a tactical routing towards the north-west to facilitate the most expeditious flight profiles and efficient use of airspace. However, due to other routes in the vicinity, it has not been possible to develop a formal flight plannable route within the procedure and airspace design requirements would reflect the normal day-to-day routing of aircraft. This is explained in more detail later in this document.

1.4. This route is currently utilised (based on Summer 2015 figures) by approximately 11 scheduled services per week[3]. It is used occasionally by non-scheduled and positioning flights within the UK and Ireland. Forecast traffic growth is expected to lead to approximately 50 flights per week by 2021.

1.5. Figure D1 and D2 below show historic tracks of easyJet and Stobart Air aircraft departing from runway 05 via EVNAS over comparable 5-week periods in July/August 2014 and 2015 respectively[4].

1.6. Also, as detailed in Section 5 of **Part A** of the Consultation Document, once aircraft are beyond the end of the NAPs they may be tactically routed by LTC or

[1] As detailed in the main body of the Consultation Document, prior to November 2015 the runway designation at LSA was Runway 06. From November 2015 the designation is Runway 05 due to magnetic variation changes. For ease of reference, the runway is referenced as Runway 05 throughout this document, notwithstanding that for the presentation of historic data it was then designated Runway 06

[2] This SID also encompasses the previous PDRs to Brookmans Park (BPK) and Compton (CPT) which are now truncated to end at the common end point LAM

[3] The particular flights utilising this route can be variable dependent on airspace conditions over Europe. Some flights will sometimes use this route and sometimes the southerly departure route.

[4] It should be noted that the departures in 2014 took place before the introduction of controlled airspace around LSA and thus may include depiction of track deviations below 3500ft to avoid unknown aircraft in proximity to their intended route.

LSA controllers for integration with other traffic flows. This is indicated by the majority of plots which continue in a north-westerly direction for tactical integration and more expeditious routing instead of turning towards LAM.

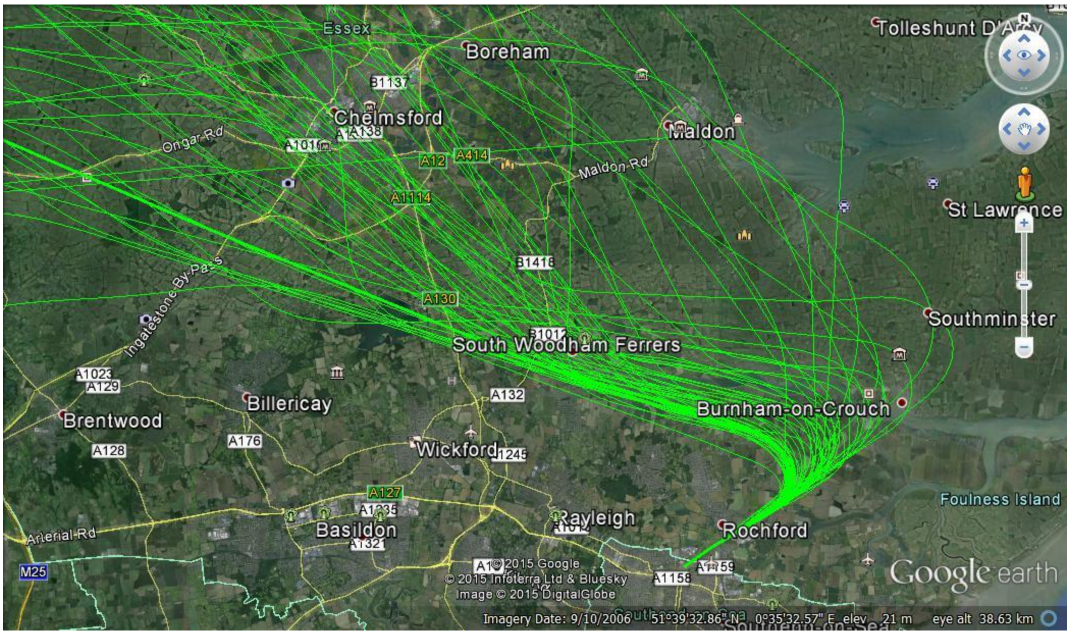


Figure D1: Runway 05. Historic departure tracks 5-week period Jly/Aug 2014 via EVNAS

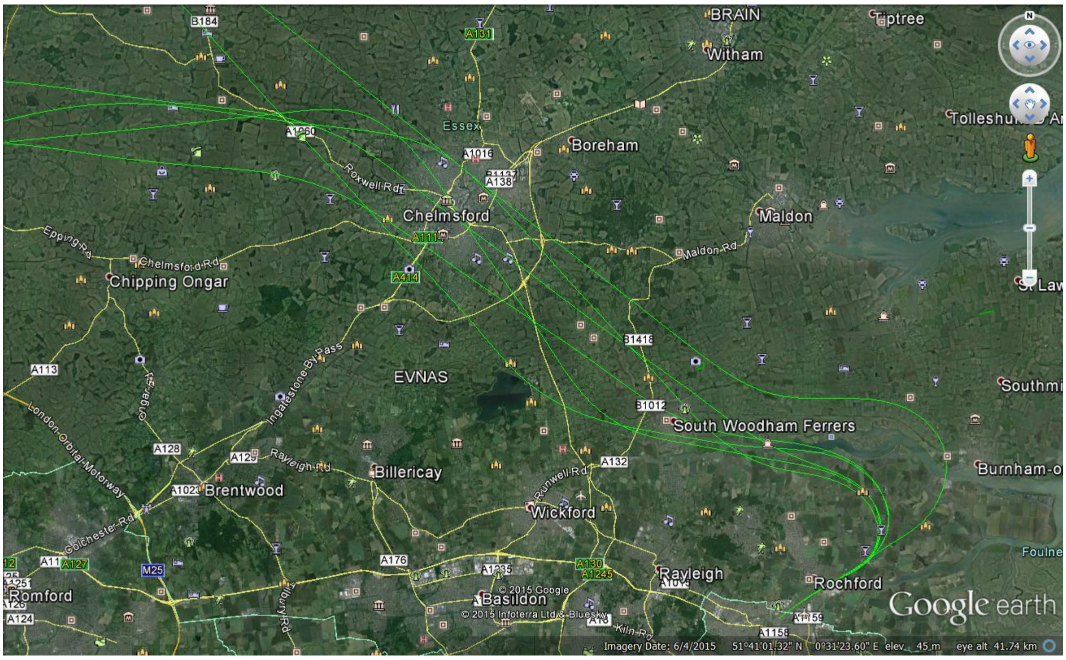


Figure D2: Runway 05. Historic departure tracks 5-week period Jly/Aug 2015 via EVNAS

2. The LAM 1G SID procedure

2.1. Climb on course 055°M to <u>MCE02</u>[5] to cross <u>MCE02</u> at or above 900ft (7% minimum climb gradient) then on course 055°M to not below 1500ft. Turn left to MCN15 on course 274°M, then to EVNAS, then to LAM. Cross MCE15 at 3000ft; cross EVNAS at 3000ft; cross LAM at 3000ft. Maximum speed 210kt IAS to MCN15 then maximum speed 250kt to LAM.

2.2. A schematic diagram of the SID is shown in Figure D3 below and a diagram of the SID overlaid on an Ordnance Survey map is shown at Appendix D1.

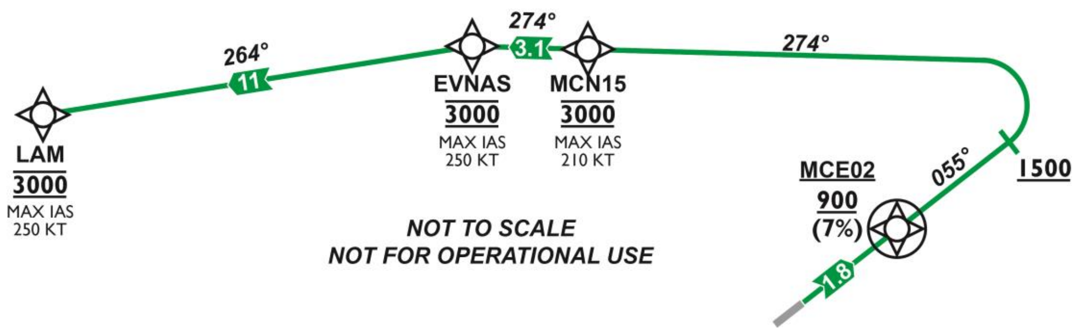


Figure D3: Schematic diagram of LAM 1G SID

2.3. Waypoint <u>MCE02</u> is a flyover waypoint located 1.8NM from the end of the runway, which reflects the earliest point at which the NAPs allow a fast climbing aircraft (i.e. above 1500ft) to turn left, as detailed in Section 15.2 of **Part B** of the consultation document. It is necessary to locate the waypoint at 1.8NM instead of at 1.0NM in order to take account of the Fix Tolerance of the RNAV waypoint to ensure that aircraft, under the worst navigational circumstances, do not start to turn before reaching 1NM from the end of the runway. The procedure then requires aircraft to continue to climb straight ahead until a minimum altitude of 1500ft has been reached, which is the lowest turn altitude specified in the NAPs. A minimum altitude of 900ft is specified at <u>MCW02</u> which is based on a 7% climb gradient.

2.4. From the end of the NAP at 1500ft (or at <u>MCE02</u> for very fast-climbing aircraft) the SID procedure turns left onto a course of 274°M towards EVNAS. The course has been determined by the nominal procedure design turn radius for a turn at 210kt and 25° bank angle, rolling out of the turn directly towards EVNAS

[5] <u>Flyover</u> waypoint designators are always underlined, flyby waypoint designators are not underlined.

2.5. An aircraft operating speed limit of 210kt has been applied to the turn to limit the radius of turn and limit the spread of the left turn (a faster flying aircraft would have a wider radius of turn).

2.6. A flyby waypoint, MCN15, has been positioned on the track towards EVNAS at a distance from MCE02 which is compatible with the procedure design criteria. It is at the minimum distance from MCE02 allowed by the procedure design criteria for a track change of 141° at 210kt. Aircraft must cross MCN15 at 3000ft, unless cleared to climb higher by ATC. The speed limit applied to the first turn is also relaxed at MCN15, although it could be relaxed earlier at ATC discretion once the aircraft has turned clear of Burnham-on-Crouch[6].

2.7. The track inbound to MCW15 and EVNAS is far enough to the north to allow arriving aircraft to runway 05 to cross above and then descend on a left-hand radar-directed circuit.

2.8. At a nominal aircraft climb gradient of 7% (425ft/NM) an aircraft would reach 1500ft approximately 3.4NM from the end of the runway and 3000ft approximately 7NM from departure. This is considered a conservative climb performance for modern aircraft but is frequently specified as a minimum in SID procedure design for ATM or other operational purposes[7]. Therefore, notwithstanding that the procedure design criteria only allow a waypoint to be positioned at MCN15, even the slowest climbing aircraft can be expected to reach 3000ft some 5NM before MCN15.

2.9. The nominal route derived from this methodology reflects, as closely as practicable within the constraints of the procedure design criteria, the historic distribution of tracks demonstrated by departing aircraft using the PDR and does not increase the track mileage for departing aircraft in comparison to the PDR.

2.10. Vertical constraints:

2.10.1. An altitude limitation of 3000ft is necessary as far as EVNAS due to converging and crossing LCY SID procedures from the west. (See Figure D4 below.) Notwithstanding that the SID procedure from runway 05 is further away from the LCY procedures than for runway 23, there is insufficient airspace available for LSA departure procedures to “jump above” the LCY procedures before coming into conflict. Therefore the safety management requirements for converging and crossing procedures require that the LSA departures must initially be limited to 3000ft.

[6] In most cases ATC will relax the speed limit after the aircraft has completed the first turn, although for procedure design purposes a speed limit can only be changed at a waypoint.

[7] At the start of the previous controlled airspace development LSA questioned local Commercial Air Transport operators on climb performance of their aircraft fleets and all confirmed that 7% climb gradient would be acceptable.

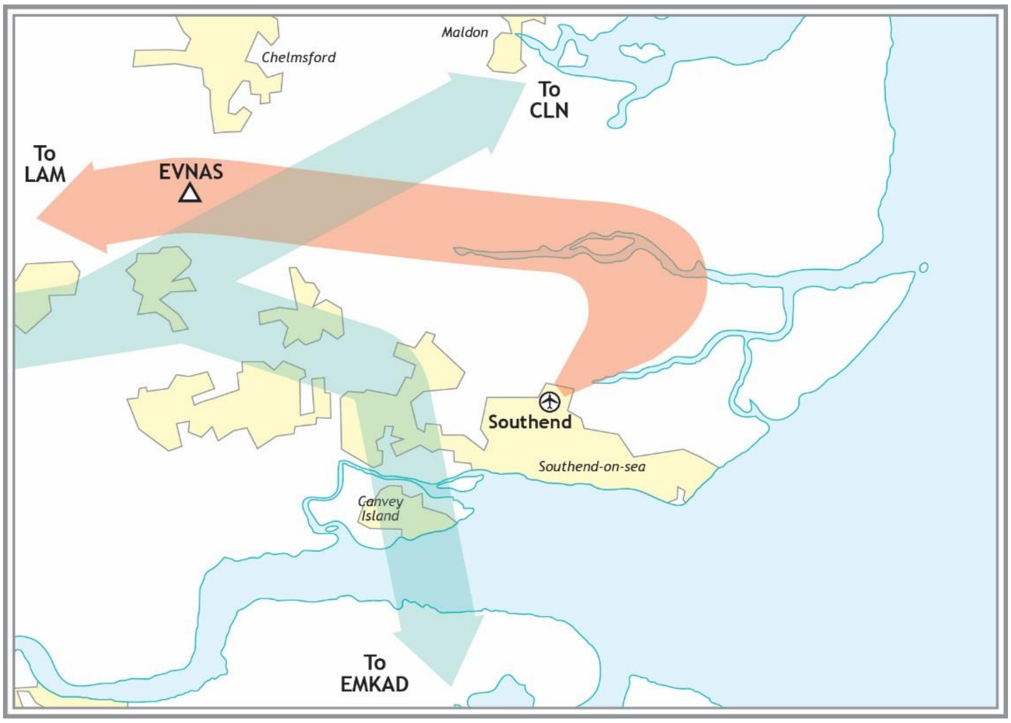


Figure D4: Schematic diagram depicting lateral conflict between LAM SID (red) and LCY CLN and EKNIV SIDs (blue)

2.10.2. After EVNAS, notwithstanding that the SID procedure is laterally separated from other flight paths, as explained in paragraph 15.3 of **Part B** of the consultation document, it is a procedural airspace design safety requirement for the published upper limit for the whole SID procedure to remain at 3000ft rather than allowing a "designed-in" climb to a higher level[8].

2.10.3. However, on a day-to-day basis, if there is not another aircraft in conflict, then aircraft departing from LSA would be given a direct climb clearance to a higher level either once in contact with the LTC radar controller or by the LSA radar controller in co-ordination with the LTC controllers. Standing Agreements will be in place between LSA ATC and LTC Sectors to ensure that climb clearance above the initial limit is given to the aircraft at the earliest opportunity.

2.10.4. Empirical evidence indicates that aircraft would regularly be expected to be above 4000ft[9] before reaching the vicinity of EVNAS, notwithstanding that it cannot, for safety management reasons detailed above, be specified within the

[8] It should be noted that the basic procedures, as published, form a vital part of the Loss of Communication procedures and thus must be "procedurally" safe with respect to other procedures and flight paths in the airspace. In the "live" traffic situation, where air traffic controllers and pilots remain in communication with each other, the controllers are able to improve on both the vertical profile and the nominal routing of the SID procedure and thereby achieve the most effective use of the airspace and efficient flight profiles for all aircraft.

[9] An A319 given unrestricted climb clearance in typical weather conditions could be expected to be at approximately 6000ft by EVNAS.

procedure. Figure D5 below provides a colour-coded plot of the achieved climb performance of departing aircraft via EVNAS over a 5-week period in July/August 2015.

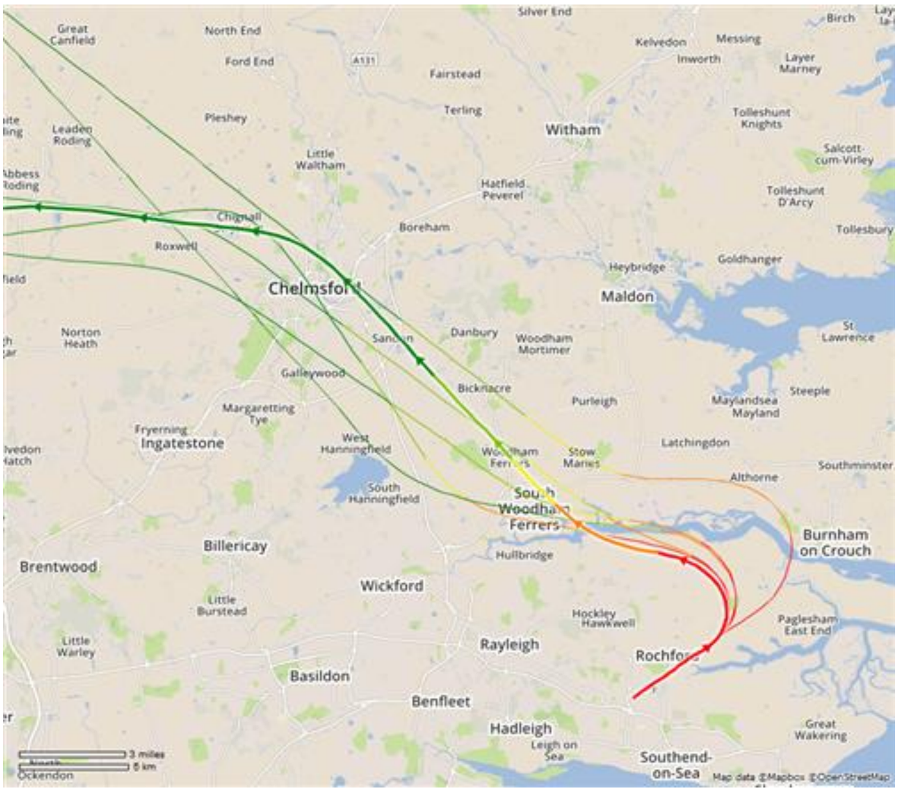


Figure D5: Colour coded climb profile of departing flights Summer 2015.
[Colour coding: Below 3000ft red; 3000 – 4000ft orange; 4000 – 5000ft yellow; 5000 – 7000ft light green; above 7000ft dark green]

2.10.5. It can be seen that for these flights, albeit a small traffic sample, all aircraft had been cleared to climb and were above 3000ft by the completion of the first turn after departure and slowest climbing aircraft was above 5000ft before reaching abeam the Hanningfield Reservoir.

2.11. Radar Vectoring

2.11.1. As noted in Sections 5 and paragraph 9.4 of **Part A** of the consultation document it is essential that controllers retain the operational flexibility to integrate aircraft flight paths with one another to achieve the most effective and efficient overall traffic flow and to get departing aircraft climbing to their cruising levels as quickly as possible. Therefore, once aircraft have completed the NAP segment of the SID procedure, controllers may use radar vectoring to achieve the most efficient and expeditious flight profiles of aircraft at the lower levels of the TMA airspace.

2.11.2. This flexibility is particularly important, and will remain so, for aircraft departing from LSA towards EVNAS.

2.11.3. Notwithstanding that the flight plannable SID routing must be via LAM for airspace design purposes, it is invariably more efficient on a tactical basis for controllers to radar vector LSA departing aircraft away from the holding pattern at LAM (for LHR inbound aircraft) and more towards the north or north-west.

2.11.4. However, there is no fixed, or predetermined track for such radar vectoring; the chosen flight path would be dependent on many factors such as the position of STN departing (runway 22) or arriving (runway 04) aircraft and Luton eastbound departures within the overall traffic flow as well as LHR arrivals. Controllers are also required to ensure that LSA departing aircraft are given prompt climb clearance so that they stay above the base levels of controlled airspace. These aspects are demonstrated clearly in Figures D2, D3 and D5 above with most aircraft being tactically routed by LTC Sectors well to the east and north of EVNAS on a direct climb towards the north-west.

2.11.5. Thus departing aircraft via EVNAS are likely to be radar vectored somewhat to the east of EVNAS and are highly unlikely to fly along the EVNAS – LAM segment of the SID. Equally, they will invariably be given climb clearance above 3000ft well before reaching the vicinity of EVNAS. However, as noted previously, it is not possible to reflect these aspects within the criteria for procedure design or the safety management requirements for the airspace structure.

3. Differences between the LAM 1G SID and the PDR

3.1. A diagram showing the proposed LAM 1G SID overlaid on the actual tracks of aircraft operating on the previous LAM/BPK/CPT PDRs is shown at **Appendix D2**. The widths of the swathes depicted in **Appendix A2** are ±1NM from the nominal route centre-line for the outer swathe, which represents the "worst case" flight safety navigational tolerance used for procedure design, and ±0.2NM for the inner swathe, which represents what we expect to be the day-to-day navigation accuracy expected on RNAV1 routes (based on experience of other ATM applications of RNAV1 operations elsewhere).

3.2. It should be noted that as the PDRs were, historically, not designed to any formal procedure design criteria and tracks to be flown were not specified with reference to the navigation infrastructure. It is therefore not possible to provide an exact comparison between the nominal tracks of the SID procedure (designed to PANS-OPS criteria) and the PDR via EVNAS – LAM (including this portion of the PDRs to BPK and CPT) The operation of aircraft on the SID will generally reflect the historic distribution of aircraft using the PDR.

3.3. Furthermore, the NAP allows for dispersion of departing aircraft commensurate with climbing performance in the first turn after departure. This, of course, cannot be depicted as a single "nominal" track. However, the SID reflects, as closely as practicable, and retains the dispersion of traffic over the sparsely populated area to the north-east of LSA afforded by the NAP.

3.4. Procedure design speed limits were not applied to the PDR, other than the standard international airspace speed limit of 250kt IAS outside controlled airspace. We have applied an initial speed limit of 210kt IAS for the SID procedure to limit the easterly extent of the initial turn by faster aircraft. In selecting an appropriate speed limit a fine balance is necessary between the preferred operating configurations and speeds of the variety of aircraft using the route and the ATM and environmental objectives. The application of the speed limit ensures that LSA departing aircraft do not fly further to the east than is necessary in the initial turn and assists in ameliorating potential overflight of the outskirts of Burnham-on-Crouch.

3.5. The diagram at **Appendix D2** shows the nominal track of the SID for a turn at 210kt at 25° bank angle in still air commencing at 1500ft based on a 7% climb gradient. Aircraft with a lower speed, or faster climb rate will demonstrate a different start of turn (as permitted by the NAP) but the Flight Management Systems will adjust the flight path of the aircraft to reflect the procedure design and will roll-out smoothly onto the track inbound towards EVNAS.

3.6. It should be noted that the nominal track towards EVNAS lies to the north of South Woodham Ferrers, whereas the main core of historic departure tracks for the PDR overfly South Woodham Ferrers. This will enable ATC to give climb clearance above 3000ft earlier and will bring an environmental advantage to the South Woodham Ferrers area. The SID procedure incorporates specific measures to ameliorate or reduce possible overflight of Burnham-on-Crouch.

3.7. With respect to the upper limit of the procedures, before the introduction of controlled airspace departing aircraft via EVNAS were permitted to climb initially to 3400ft. This was to ensure that the aircraft remained outside controlled airspace until given further climb clearance by LTC, the base level of controlled airspace being 3500ft. However, where both aircraft are inside controlled airspace the vertical separation to be applied by ATC is 1000ft. Thus, with the introduction of controlled airspace at LSA in April 2015 the upper limit of the PDRs has been changed to 3000ft. To ensure that standard separation is sustained with the introduction of SIDs, the initial level incorporated in the procedure design for LSA SID procedures must be 3000ft.

4. Other options considered

4.1. **Use of flyby waypoints**:

4.1.1. The use of flyby waypoints throughout the procedure design, which would be the preferred methodology for aircraft navigation systems, was considered in the outline development of the procedure design.

4.1.2. However, the positioning of an initial flyby waypoint (to define the start of the first turn following noise abatement) which would meet the procedure design criteria would not allow the flexibility and dispersion which is embodied within the NAPs for aircraft of different climb performances. All aircraft would be committed to following the same nominal track. .

4.1.3. Furthermore the initial waypoint under the procedure design criteria would be close to Burnham-on-Crouch in order to capture the slower climbing aircraft, resulting, as a consequence, in a greater number of faster-climbing aircraft flying closer to Burnham-on-Crouch before starting to turn.

4.1.4. Moreover, as the turn towards EVNAS is greater than 120°, the turn would need to be defined as two consecutive turns of less than 120° in order to comply with the procedure design criteria for flyby waypoints.

4.1.5. In combination, these factors would have added track mileage to the flight paths of many departing aircraft, resulting in increased fuel burn for no operational or environmental advantage.

4.1.6. Conversely, using a flyover waypoint, together with CA, to define the start of the turn would allow a single turn of more than 120° to be used and indicated that aircraft would more closely replicate the tracks flown on the PDRs, albeit to the north of the core of current tracks, and would allow the dispersion of departing aircraft of differing climb performance, as provided for in the NAP, to be retained.

4.1.7. Therefore, LSA has elected to utilise the flyover waypoint configuration, together with CA to enforce the minimum turn altitude requirement, for the procedure design configuration rather than flyby configuration.

4.2. **Direct to LAM**:

4.2.1. A more southerly track, to the south of Hanningfield Reservoir, would increase overflight of Billericay and Brentwood and would conflict with aircraft inbound to runway 05 at LSA. The conflict with LCY departures via CLN would be exacerbated, resulting in less ability to climb LSA departures above 3000ft.

4.2.2. Furthermore, notwithstanding that the formal SID procedure must be specified via LAM for flight plannable linkage to the LTMA route structure, the day-to-day ATM tactical requirement for efficient airspace utilisation and expeditious climb clearance is to route departing aircraft further to the east and north. A procedure design routing directly to LAM would be less representative of the ATM requirement.

4.2.3. Therefore, this option is ruled out.

4.3. **An earlier left turn**: This would entail a change to the noise abatement procedures by lowering the altitude at which aircraft could start a left turn. This would not be compatible with the LSA environmental objectives and would result in greater overflight of Rochford. LSA is not seeking to change the long-standing NAPs which are the subject of a Section 106 Agreement. Therefore, this option is ruled out.

4.4. **A later left turn**: This option is not desirable. It would increase overflight of Burnham-on-Crouch by departing aircraft. It would also impact adversely on the overall efficiency of the ATM operation. The increased track mileage would impact adversely on fuel burn and emissions. This option is therefore ruled out.

4.5. **More northerly route to the east and north of EVNAS**: This possibility was considered in detail in the airspace development stage as tactical (radar directed) routing of aircraft in the pre-controlled airspace era often used this method of tactically expediting departing traffic. Whilst a more northerly route would have avoided the congested uncontrolled airspace around Hanningfield Reservoir in the design of the Southend CTR/CTA this has been mitigated in the design of the new controlled airspace. Complex procedural lateral and vertical conflict would exist against STN inbound and outbound traffic[10] and the new, more easterly orientation of routes for LCY inbound traffic. Extensive and detailed studies by NATS and LSA were unable to devise a safe, standard and flight plannable route though the north-eastern part of the LTMA for LSA departures. This option is therefore ruled out.

4.6. **Higher procedure altitudes:** Extensive and detailed studies were carried out by LSA and the NATS LAMP development team to try and establish an upper limit above 3000ft at EVNAS for the LSA departure procedure. However, the safety management requirements for resolution of the procedural conflict with LCY departure procedures converging from the west and crossing above (see Figure D4), together with the routing of LSA arriving aircraft joining a left-hand radar-directed circuit to runway 05, preclude the specification of a higher altitude within the procedure before EVNAS. Furthermore, the safety management requirements with respect to “stepped climbs” and SSR Mode S depiction on LTC radar controllers data displays (as explained in paragraph 14.3 of **Part B** of the

[10] LAMP Phase 1a requires a greater use of the easterly departure routes from STN

consultation document) has precluded the specification of higher levels in the published procedure. However, as detailed above, empirical evidence shows that on a day-to-day basis the majority of LSA departing aircraft will be given climb clearance and most will have achieved levels above 5000ft before reaching EVNAS and will be tactically routed away from the SID route in order to ensure expeditious climb clearance above 3000ft can be given.

5. Environmental impact

5.1. It can be seen from the diagram at **Appendix D2** that the nominal route of the SID passes over the sparsely populated areas to the north-west of LSA in the initial turn and then passes to the north of South Woodham Ferrers, whereas the majority of aircraft departing on the PDR have flown over South Woodham Ferrers.

5.2. The dispersion of the initial turn of departing aircraft towards less populated areas by aircraft of different climbing performance afforded by the NAP has been retained.

5.3. The Airport Noise Contours are not affected by the change from PDR to SID as detailed in **Part A** Section 7 of the consultation document. The increase in contour size from 2014 to 2021 would occur irrespective of whether the departure procedures remain as current or are changed to SIDs.

5.4. The introduction of a speed limit for the initial turn of the SID, together with a specified track towards EVNAS, will reduce the spread of aircraft tracks around the turn and the routing to the north of South Woodham Ferrers, thereby reducing the number of people affected by departing aircraft on this route.

5.5. The SEL Chart at **Appendix D3** shows a change to the alignment of the "far out" extremity of the 80dB(A) SEL contour. This is due to the position of the first flyover waypoint which defines the NAP as a consequence of the PANS-OPS procedure design criteria.

5.6. **Table D1** below shows the area and population within the 80 and 90 dB(A) SEL footprints for departures by the Airbus A319 on the current route and the proposed SID procedure.

SEL Value	Runway	Route	Area (Km^2)		Population (thousands)	
			Current route	SID	Current route	SID
90 dB(A)	05	LAM	2.4	2.4	1.0	1.0
80 dB(A)			12.7	12.5	9.2	8.6

Table A1: SEL Footprints LAM PDR and LAM 1G SID

5.7. The Chart at **Appendix D4** shows the departure swathes against which population counts have been made. The criteria against which the swathe widths and length have been determined are detailed in **Part A** Section 9.5 of the consultation document. Whilst the swathe widths reflect the general practice used at other UK airports it should be noted that we expect the day-to-day track-keeping performance for departing aircraft using the RNAV1 SID procedures to be better than the 2km swathe width used for this analysis.

5.8. **Table D2** below provides a comparative count of the number of people within the respective swathes for the historic PDR and the proposed LAM 1F SID.

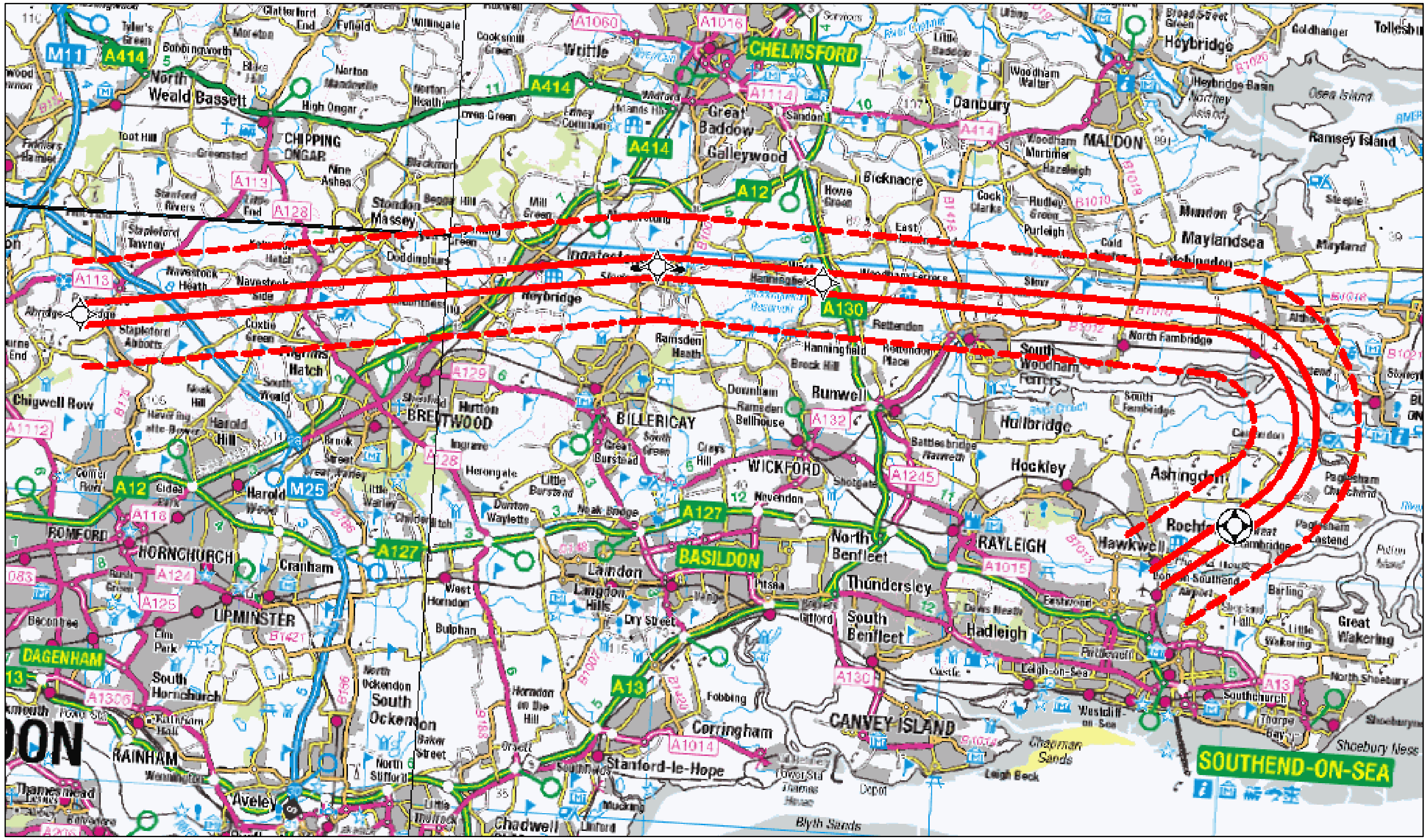
Runway	Route	Population (thousands)	
		Current Route (PDR) (nominal 3km width)	SID (nominal 2km width)
05	LAM	6.5	2.0

Table A2: Population Count for PDR and SID

5.9. The introduction of properly constructed RNAV SIDs with a navigation standard of RNAV-1 will result in improved repeatability of tracks in accordance with CAA Policy and DfT guidance. The SID, in conjunction with the recently introduced controlled airspace around LSA and the improved airspace efficiency resulting from the recently introduced LAMP Phase 1a airspace arrangements, will enable earlier climb clearance to be given to departing aircraft above the 3000ft initial limitation of the SID procedure. However, tactical radar vectoring of aircraft before reaching EVNAS will remain an operational requirement in order to achieve the most efficient flight profiles and use of airspace further away from LSA.

5.10. Therefore, it is concluded that the impact of changing the PDR to a formal SID procedure brings an overall environmental benefit to communities on the ground as well as to improved flight profiles and reduced fuel burn for aircraft operators.

Appendix D1 Diagram of LAM 1G SID overlaid on OS topographical map



LAM 1G SID: Diagram showing the anticipated maximum track dispersion (±0.2NM; solid red lines) and the maximum navigation tolerance (± 1.0NM; dashed red lines) overlaid on Ordnance Survey map. [NB Aircraft are not expected to follow the SID all the way to LAM. See text for details.]

Appendix D2 Diagrams of LAM 1G SID and historic tracks of aircraft flying on the LAM PDR.

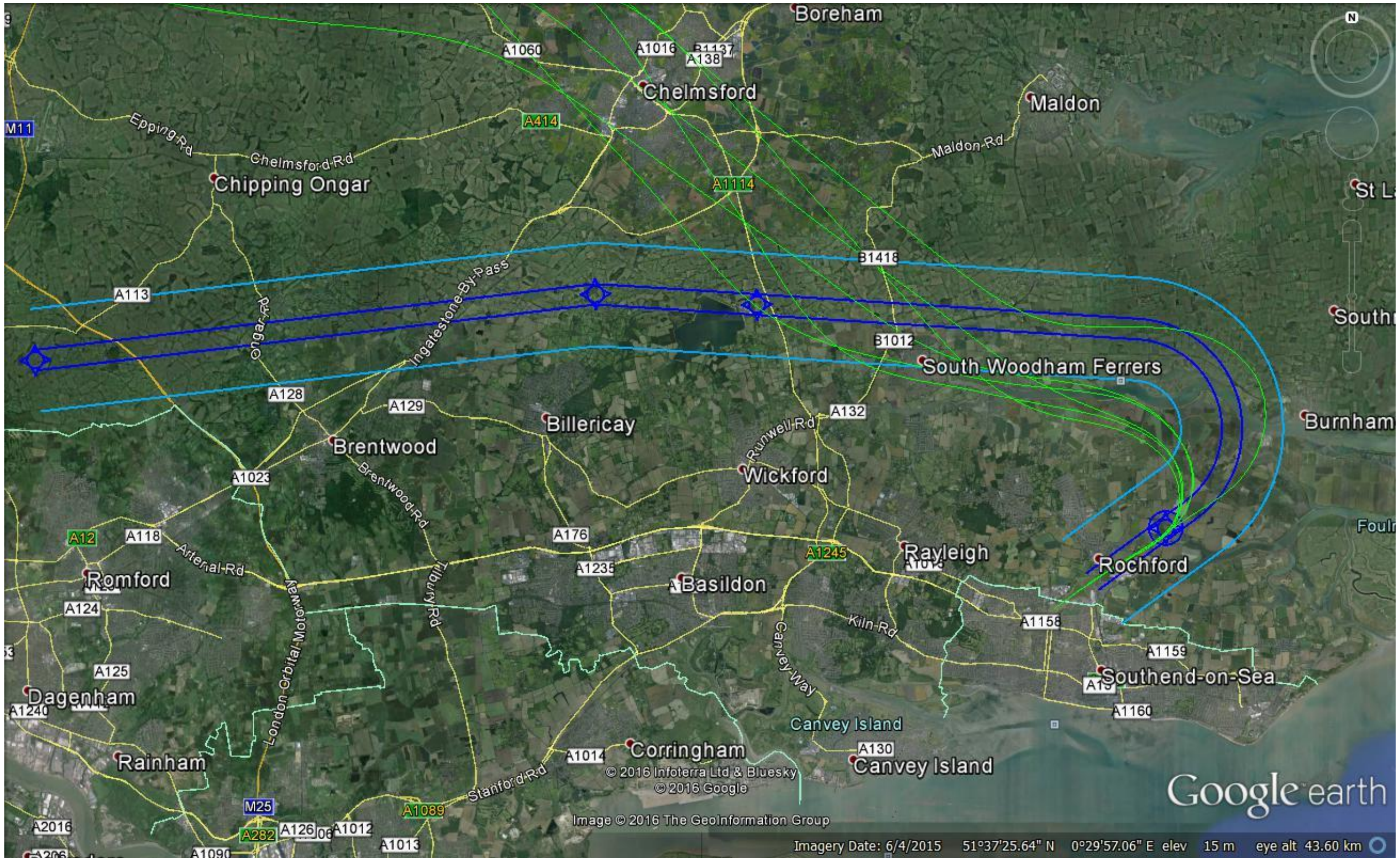


Diagram showing the anticipated maximum track dispersion (±0.2NM; dark blue) and the maximum navigation tolerance (± 1.0NM; light blue) for the LAM 1G SID against historic NTK tracks (green) for departing aircraft July/August 2015. [NB Aircraft are not expected to follow the SID all the way to LAM. See text for details.]

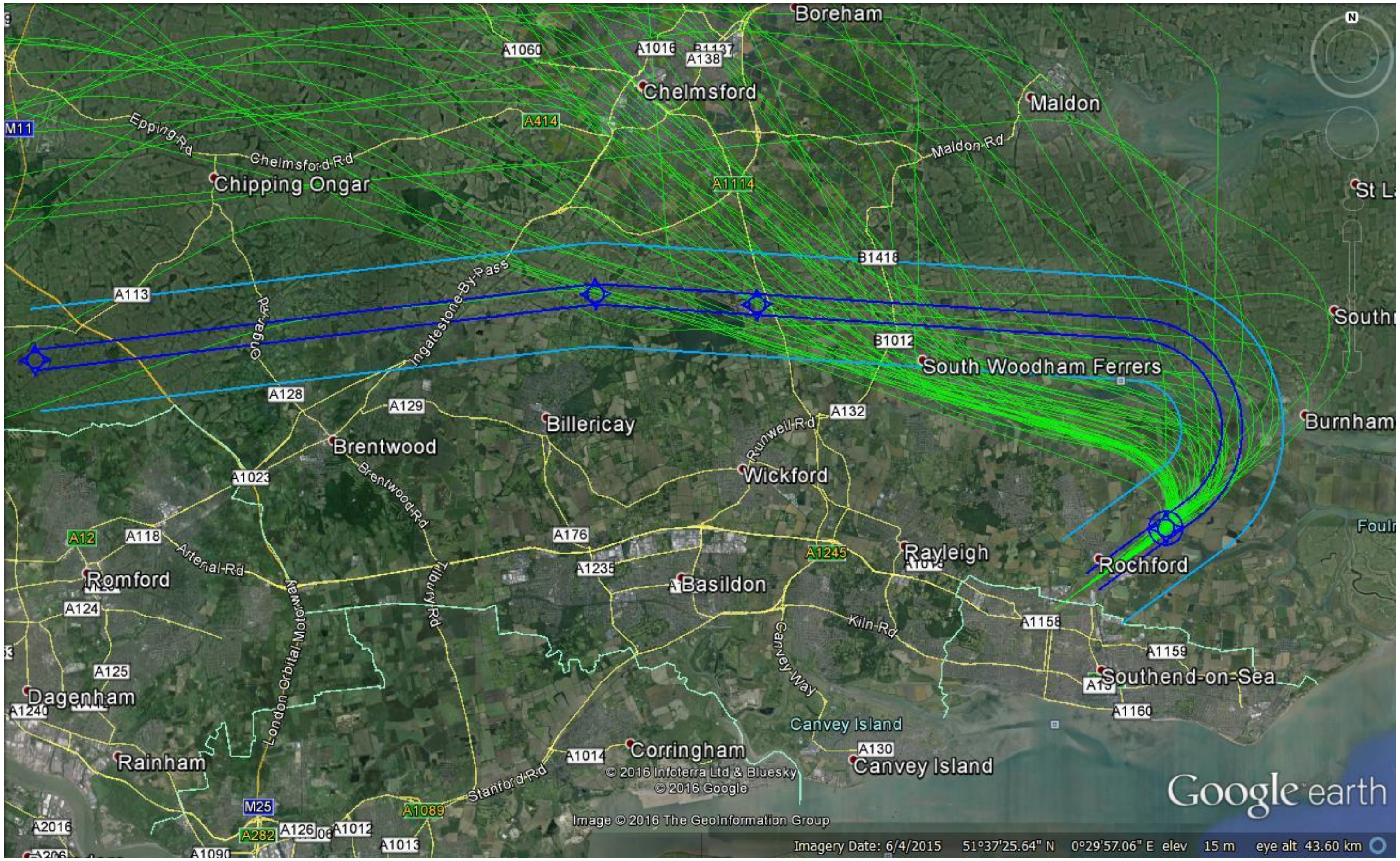
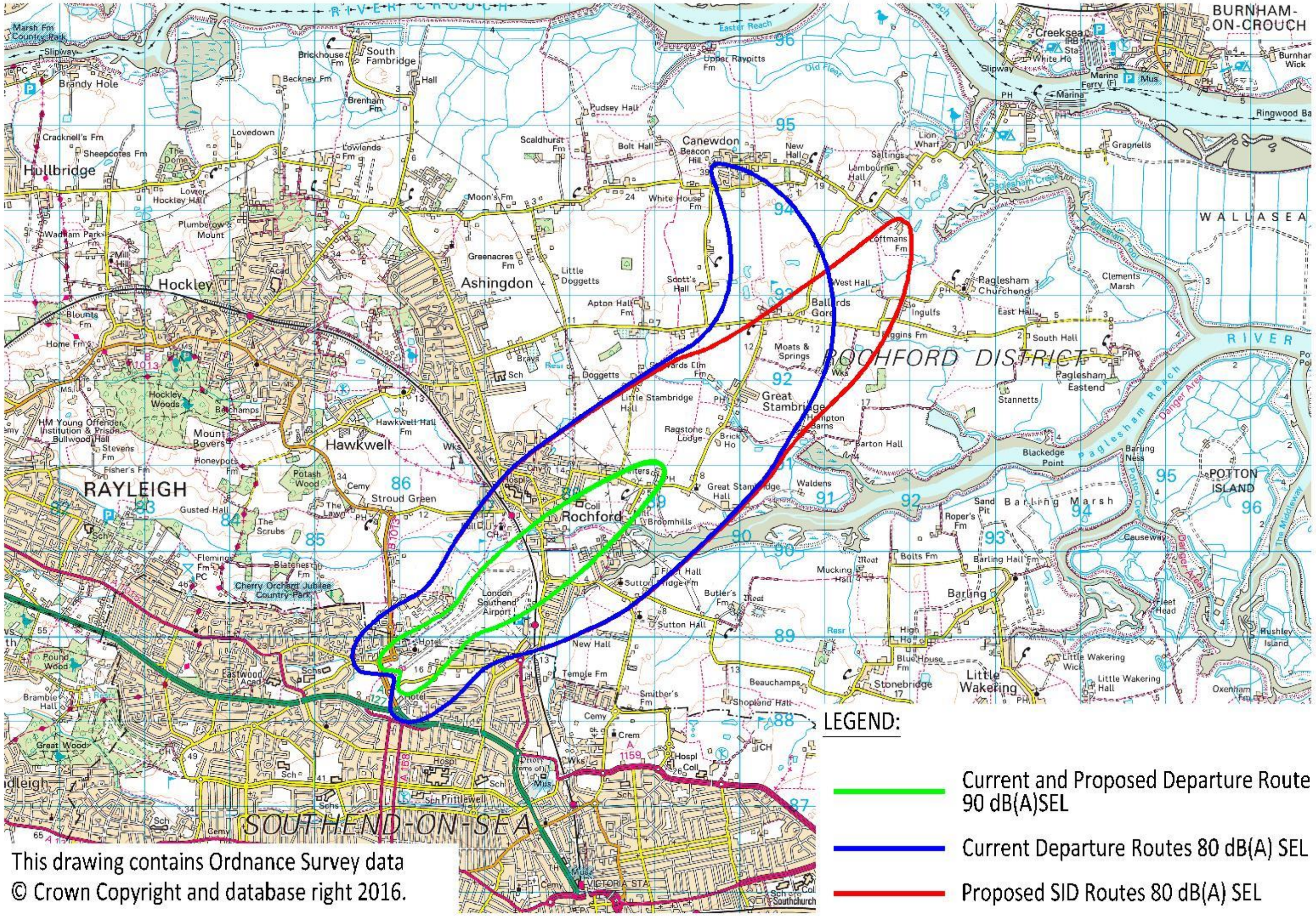
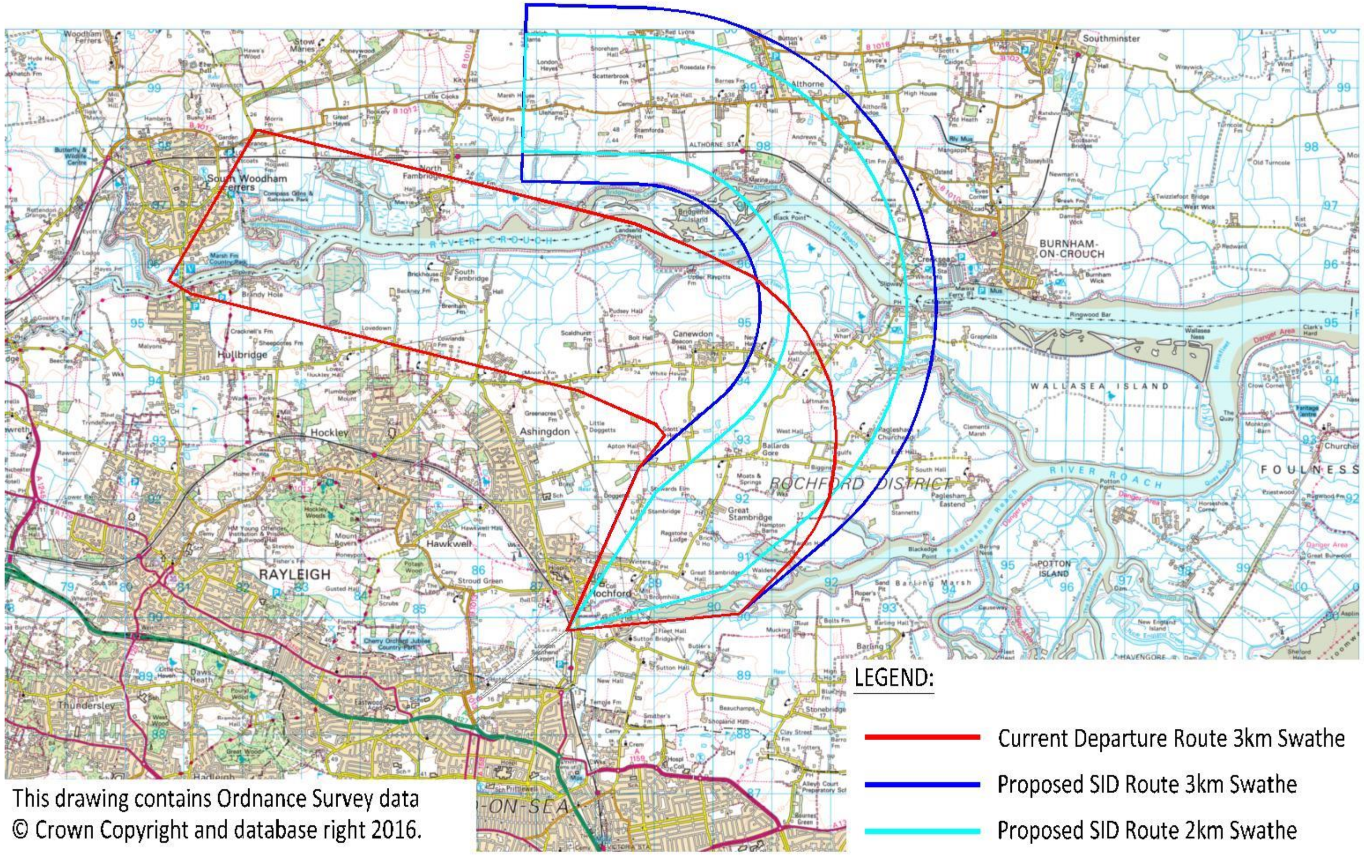


Diagram showing the anticipated maximum track dispersion (±0.2NM; dark blue) and the maximum navigation tolerance (± 1.0NM; light blue) for the LAM 1G SID against historic NTK tracks (green) for departing aircraft July/August 2014. [NB Aircraft are not expected to follow the SID all the way to LAM. See text for details.]

Appendix D3 SEL Chart for A319 aircraft.



Appendix A4 Departure swathes for LAM PDR and LAM 1F SID



(See Part A paragraph 9.6 for explanation of swathe widths and length.)